

**SINGLE PLY ROOFING SYSTEMS AND METHODS  
OF CONSTRUCTING THEM**

**TECHNICAL FIELD OF THE INVENTION**

**[001]**        The invention relates to roofing systems of the type secured to generally flat roof decks and comprised of flexible synthetic membranes with overlapped and bonded edges.

**BACKGROUND OF THE INVENTION**

**[002]**        Single-ply membrane sheet roofing systems are very well recognized and widely in use as both new and renovated exterior roof surfaces for a multiplicity of building structures having generally flat roof decks. Such deck sheets today are custom prefabricated in the factory by Duro-Last, Inc., applicant's assignee, to the exact dimensions of the building roof and furnished, with weight considerations in mind, in rolled transportable sections of up to 2500 square feet to the roofer on site. Other single-ply roofs are largely worker-constructed at the site and bonded by the roofer on the site. Presently, in the case of Duro-Last, Inc. up to eighty-five percent of the field seams can be completed in the factory under ideal factory conditions, eliminating waste, saving labor, and preventing leaks. A number of such roofing systems are utilized for large footprint roofs, such as factories, administrative buildings, schools, and office buildings, for example. The present invention is concerned with improvements which are particularly

suited to the more difficult-to-install systems where the number of necessary fasteners utilized, from the standpoint of labor cost, must be kept to a minimum, while still effectively performing their function.

### **SUMMARY OF THE INVENTION**

**[003]** The present invention is directed to a combination of a first membrane with a longitudinally extending free edge secured to a roof deck by fasteners and a second membrane with an edge portion overlapping the first membrane edge and factory weld-bonded to the first membrane by means of a continuous bond between the substantially very edge of the second membrane so that the first membrane edge projects forwardly from the bond to define a fastening projection or tab extending forwardly upon the roof deck.

**[004]** When the second membrane is peeled upwardly, back from the bond and fastening projection, the fasteners are placed along the fastening projection to secure the fastening projection of the first membrane to the deck. With the second membrane still in peeled-back position, a fast-drying adhesive is applied over the fastening edge and fastener, from the factory bond forwardly, and provides a continuous adhesive coating from the first membrane projection over the fasteners and fastening tab or projection. Thus, a continuous monolithic bond, including the factory bond, and extending forwardly over and beyond the fastening tab and fasteners is provided in the preferred system illustrated. When the second membrane (which also preferably has its underside appropriately coated with the same

adhesive) is lowered to cover the fastening projection and the deck forwardly thereof, a substantially continuous layer of material, created by the factory welding and on site adhesive coating, provides in conjunction with the mechanical fasteners a novel monolithic joint or seam.

**[005]** One of the prime objects of the invention is to provide a roofing system which is exceptionally resistant to wind up-lift forces in areas of the country in which wind forces are particularly strong and hazardous to roofs.

**[006]** Another object of the invention is to provide a membrane system in which the fasteners used need not be of the barbed character presently in wide use for gripping the membrane to resist wind up-lift forces.

**[007]** Another object of the invention is to provide a labor-saving installation requiring a reduced number of fasteners when the roof deck is a difficult structure to roof (such as concrete) which must be drilled to receive the fasteners and is labor and cost intensive.

**[008]** Another object of the invention is to provide an inexpensive, mechanically secured single-ply roofing system which is extremely durable under a wide range of wind conditions and in a variety of climates.

**[009]** Another object of the invention is to provide an economically installed single-ply roofing system of reliable sealed quality which is manufactured in substantial part in the factory to ensure quality control in a sheltered working environment with specially trained employees.

**[0010]** Another object of the invention is to provide equal-lateral pull resistance over the fastener lap, thus uniformly spreading up-lift load through the fasteners into the deck.

**[0011]** Other objects and advantages of the invention will be apparent to those skilled in the art. The preferred embodiments disclosed herein are disclosed by way of example and not intended in any way to restrict the language of the claims which follow.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0012]** These and other objects, features and advantages of the invention will become more readily apparent in view of the following detailed description, appended claims and accompanying drawings, in which:

**[0013]** Figure 1 is a schematic fragmentary top plan view showing part of a multiple first and second membrane sheet secured to an underlying deck structure;

**[0014]** Figure 2 is a similar view of the factory supplied roofing sheet only;

**[0015]** Figure 3 is an enlarged sectional elevational view taken on the line 3-3 of Figure 1 to illustrate a membrane system in secured position on a roof deck; and

**[0016]** Figure 4 is an enlarged schematic prospective elevational view illustrating a preferred method of applying the system to a roof deck.

### **DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**

[0017] Referring now more particularly to the accompanying drawings, it should be understood that the roofing system, generally designated S, and secured on roof deck D is comprised of a series of membranes, generally designated M, which are factory welded along their lapped edges to form the multiple membrane sheet, generally designated S. In Figures 1-4, an adjoining pair of such membranes are numbered generally 10 and 11.

[0018] As shown in Figures 2-4, the factory weld 12 extends in a longitudinal direction from the outside edge 12a about an inch to the edge 12b. This weld can be accomplished in the factory under quality control conditions and may comprise a hot air weld effected by hot air (i.e. at a temperature of around 1200°F) which heats the sheets 10 and 11 at the edge of sheet 11 to a welding temperature wherein their confronting thermoplastic surfaces partially melt and form a weld bond of material 12. The weld may also be created by a die electric or radio frequency welding process, or other known heat welding or bonding methods. "Factory" welds are recognized to be more reliable than hot air field welds to achieve water-tight seams.

[0019] The sheet S, comprised of multiple membranes M, welded in the manner disclosed in the factory, can be supplied to the roofer in rolled sheets of, for example, 2500 square feet in the weld bonded condition shown in Figure 2. Securement of sheet S to the roof can then take place progressively in the manner indicated in Figure 4. With the upper sheet 11 peeled back about its welded edge 12b, fasteners or screws 13 with heads

13a extending through square countersunk steel load distribution plates 14 anchor the sheet S.

**[0020]** The roof deck D can be comprised of many known surfaces or substrates, such as concrete, wood, asphalt, coal tar, steel, cementitious wood fiber and the like, and, for purposes of illustration only, is shown in Figure 3 as comprised of an insulation board sheet 15 on a wood deck 16, which may be supported by suitable purlins or deck supporting structures in the conventional manner.

**[0021]** Once the fasteners 13 are secured in position with a suitable rotary power tool, a roller applicator or roller brush, generally designated B, having a handle 16 may be used to apply a fast-drying liquid adhesive to the surface of the fastening tab or projection 10a, defined by the parting line 12b forwardly and across the fastening projection 10a to provide a coating 17 (Figure 3) completely covering both the fastening projection 10 along with the fastener heads 13 and the plates 14. The completely sealing coating 17 also is applied to the free edge 10c of the fastening projection 10a and to the deck member 15 forwardly of the edge 10c for a predetermined distance 17a, i.e. six inches (6"). It is preferably applied as well to the underside of the membrane 11 from weld edge 12b forwardly for a distance so as to mate with the portion 17a of the coating 17 which is provided on the deck member 15. Because the membranes 10 and 11 are sufficiently flexible, the membrane 11 folds downwardly as at 11a to follow the edge 10c and adhesive fills the

space between them as at 17b. Finally, as Figure 3 indicates the adhesive film 17-17a feathers out, as at 17c, on the deck member 15.

**[0022]** As indicated previously, not only is the strip S securely fastened in position mechanically by the fasteners 13 extending through each fastening projection 10, a substantially continuous monolithic bond is formed by the "factory" weld bond 12 and the "field" adhesive coating 17 to interact with the fasteners 13 and prevent wind lift-up forces from applying unevenly and cocking the securing fasteners 13 in a manner to tear the membrane. While various of suitable fast-drying liquid adhesives are possible, one such adhesive which will work to secure the membranes in the field is manufactured by Sovereign Specialty Chemicals of Cincinnati, Ohio. With the present system the number of fasteners 13 which need be used to secure the strip S in terms of resisting wind up-lift is considerably fewer. Resistance to membrane tearing, and membrane peeling particularly, is greatly increased and any tendency to pull the fasteners up at cocked angles rather than straight up is considerably reduced by this monolithic structure.

### **METHODS OF OPERATION AND CONSTRUCTION**

**[0023]** Figures 1-4 particularly disclose the method of construction of the roof system and the resulting product. Each overall sheet S is comprised of a number of adjacent membranes 10 and 11, each of which has a fastening projection 10a formed by overlapping an edge portion of each membrane at the joint or seam. The sheet S is applied in the manner

illustrated in Figure 4, with each of the fastening projections 10a successively secured in position by fasteners 13 and sealed by adhesive bonding as at 17, 17b, and 17a until the end edge of the opposite end of the sheet S shown in Figure 4 is laid down and secured. The sheet is supplied to the site in a roll which, after the first edge is fully unwound and peeled back to expose each fastener tab 10a. Tautening "Grip-pull" devices of a conventional nature are used in the usual manner to remove wrinkles as the tabs 10a are progressively fastened and to keep each membrane taut as it is brought down to the deck to unite the adhesive on the underside of membrane 11 with the adhesive on tab or ledge 10a and over fasteners 13 and plates 15. If an edge of a sheet S is to be joined to the edge of a membrane, such as a parapet membrane, for example, it may be so joined in any acceptable manner on the site by the roofer, such as by hot-air welding of the overlapped edges with mobile implements, which are well known in the art .

**[0024]** Typically the membranes used may be forty mil membranes, with the membrane consisting of polyester fabric cores coated on each side with polyvinyl chloride or another thermoplastic. Duro-Last, Inc. of Saginaw, Michigan, produces highly suitable membranes of this character. Various other roofing membrane sheets, including synthetic rubbers or elastomers such as EPDM and CPE, or others which may be classified as thermoplastic synthetic resins or polymers and are flexible, are believed also suited. While a membrane thickness of .040 inches is normal, the membrane size may, for



example, be anywhere in the neighborhood of .030 to .080 in thickness, and may contain various reinforcing materials in the form of fibers or fabrics.

**[0025]** It should be understood that the foregoing disclosure of the invention is descriptive only of preferred forms thereof, and that the spirit and scope of the invention are to be limited only by the terms of the claims appended hereto.